Principal Component Analysis

# PCA and projection of images to eigenvectors set

Wavelengths 380 nm and 780 nm are removed from the dataset (no signal at these wavelengths).

Data: = (676 x 844) x 39

## Using SVD

The data are centered, subtraction of (images averaged for each wavelength)

SVD

The eigenvectors (columns of ) are called principal axes or principal directions of the data. Projections of the data on the principal axes are called principal components.

From Eq() and Eq()

Showing the projection of , the centered data, on the principal directions.

Reduction of data using k of the image eigenvectors

Reconstruction of dataset (no centered)

## Using Matlab pca()

[coeff,score,latent,tsquared,explained,mu] = pca(T)

Comparing to the SVD

The scores are the principal components of the data.

## PCA with another dataset

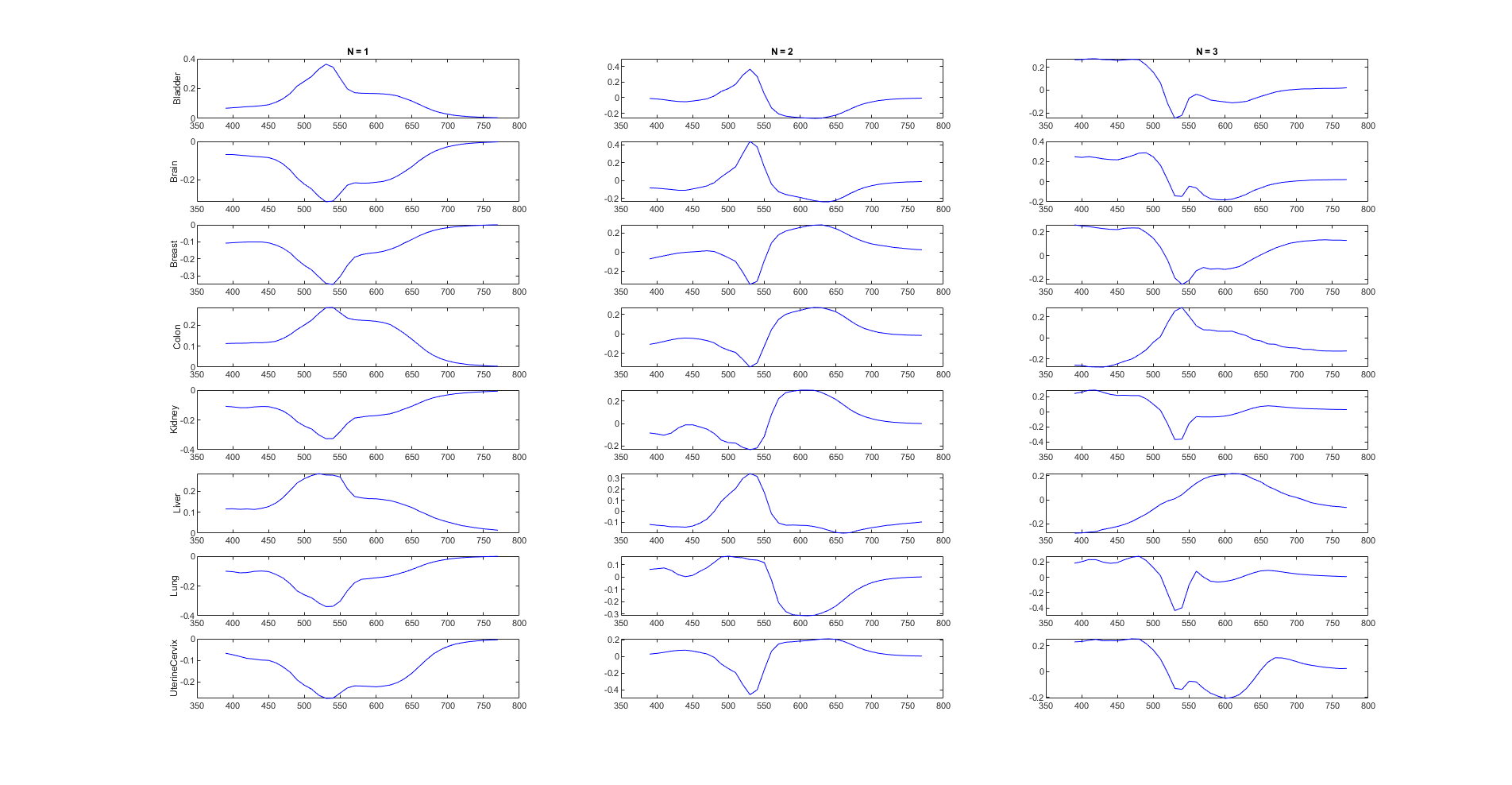
We can also write the data as

Where are the coordinates of the projection of the centered data in the eigenspace of . We find then

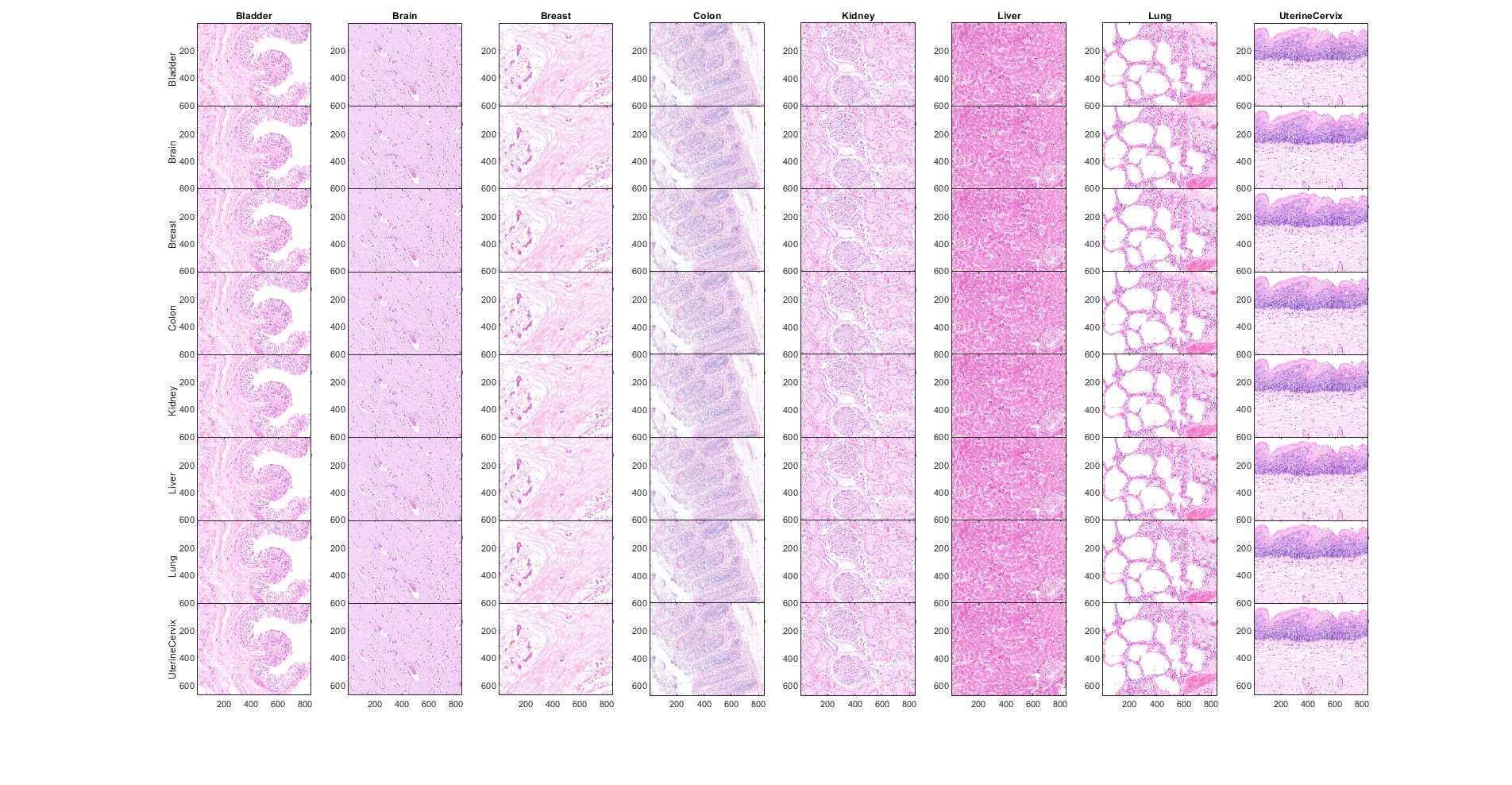
This formulation is only valid in the eigenspace defined by the eigenvectors of the centered data .

When projecting an image Img1 in the eigenspace defined by another image Img2, the reduction of the data using k eigenvectors of Img1 is formulated differently. The data of Img2 is projected in the eigenspace of Img1 as then the results is reduced considering the number of eigenvectors of Img1 that are considered

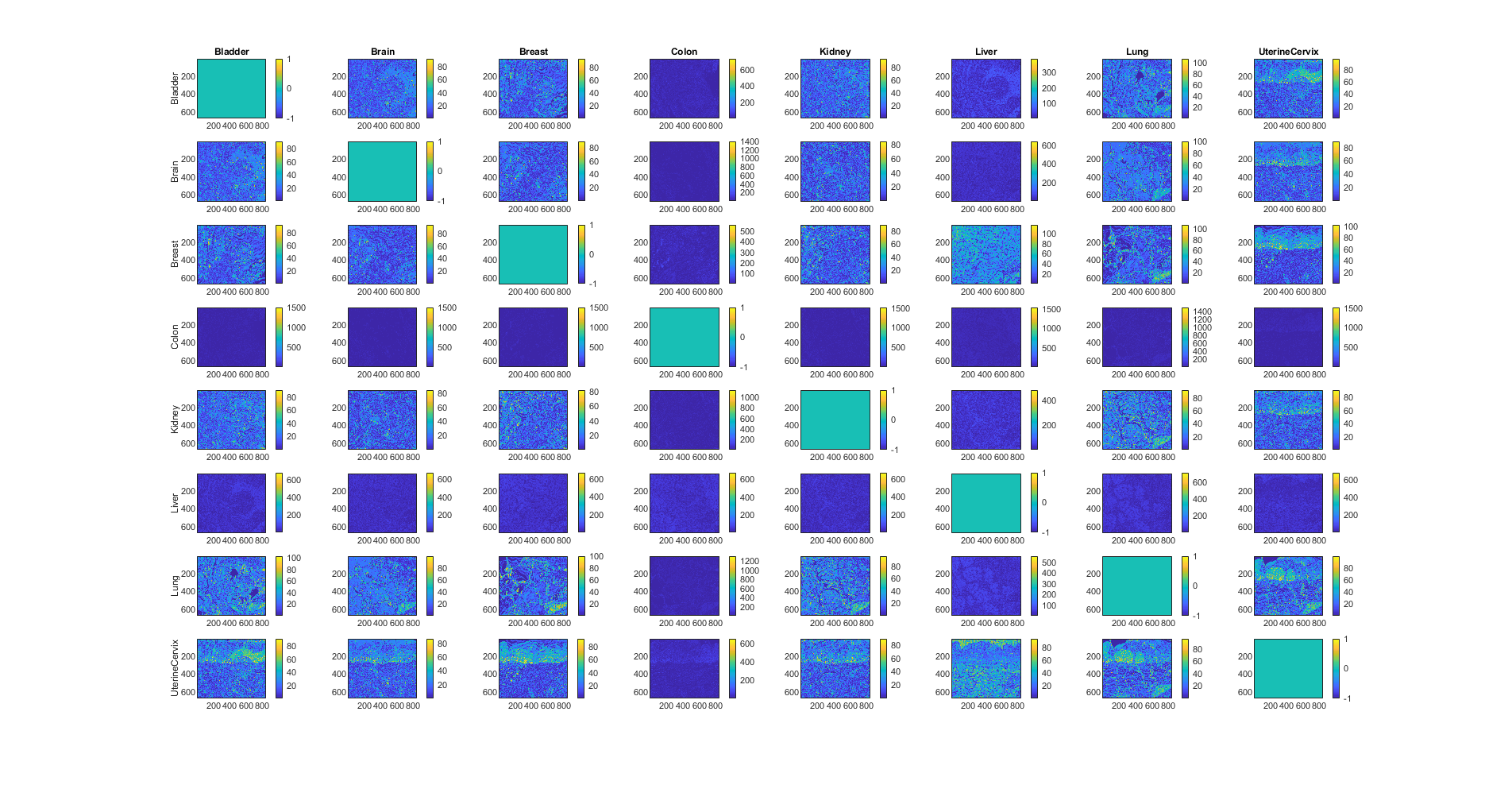
Reconstruction of dataset (no centered)

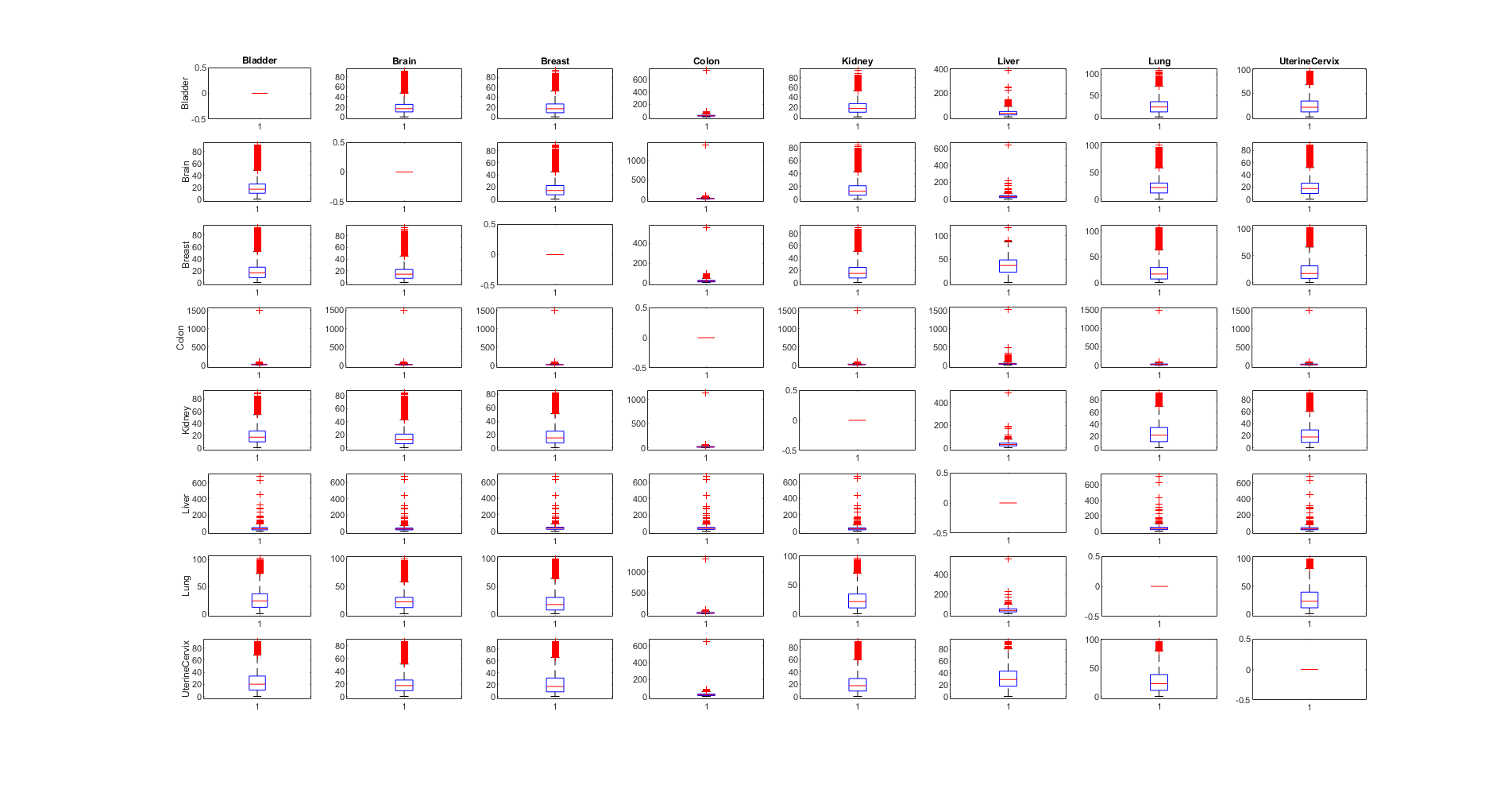
3 eigenvectors

Projected images, 3 eigenvectors: 1rst row: the images are projected in the eigenvector space of the bladder sample and so on



Heatmaps, 3 eigenvectors: 1rst row: the images are projected in the eigenvector space of the bladder sample and so on





Max dE color difference

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 0.00 | 92.35 | 93.10 | 739.83 | 94.09 | 390.00 | 107.63 | 97.89 |
| 91.15 | 0.00 | 89.42 | 1400.62 | 84.55 | 643.57 | 100.54 | 89.05 |
| 92.29 | 93.71 | 0.00 | 563.04 | 89.27 | 117.96 | 106.94 | 102.12 |
| 1504.49 | 1500.60 | 1504.86 | 0.00 | 1514.18 | 1533.63 | 1493.65 | 1514.33 |
| 90.40 | 84.41 | 82.42 | 1139.83 | 0.00 | 487.28 | 91.99 | 90.94 |
| 679.58 | 674.56 | 671.25 | 674.25 | 671.47 | 0.00 | 710.40 | 680.65 |
| 102.69 | 99.64 | 100.01 | 1311.08 | 96.25 | 560.47 | 0.00 | 99.55 |
| 90.95 | 86.61 | 92.43 | 649.41 | 89.09 | 93.39 | 96.66 | 0.00 |